

LISTING OF THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1 - 34 (Canceled)

35. (Previously Presented) An endoscope system for imaging an object in a living body, comprising:

- a light source for radiating irradiation light to said object to produce reflected and fluorescent light;

- an endoscope having an elongated insertion part capable of being inserted into said living body;

- a solid-state imaging device having a variable amplification factor being variable without loss of resolution and provided to said endoscope for receiving said reflected and fluorescent light and outputting a variable amplitude related signal;

- a signal processor for processing said output signal from said solid-state imaging device and producing a video signal;

- a display device for receiving said video signal and displaying an image represented by said video signal;

- a controller for controlling said amplification factor in said solid-state imaging device in response to said reflected and fluorescent light to provide greater amplification for said received fluorescent light than for said received reflected light;

- a variable light diaphragm in an optical path linking said light source means and said object and controllable based on said output signal from said solid-state imaging device to pass greater or lesser amounts of light from said light source means, and

- a switching device for switching said irradiation light from said light source to provide a first spectrum to excite a fluorescent substance contained in said object and a second spectrum including at least a part of a spectrum of visible light; and

a wavelength limiter in an optical path linking said object and said solid-state imaging device for preventing transmission of light with wavelengths in said first spectrum and permitting transmission of light with wavelengths in at least a part of a fluorescent spectrum of said fluorescent substance and in at least a part of said second spectrum.

36. (Currently Amended) An endoscope system for imaging an object in a living body, comprising:

a light source for radiating irradiation light in at least a visible and non-visible spectrum to said object to produce reflected and fluorescence light;

a light switching device in an optical path between said light source and said object for switching between said visible and non-visible spectrum to irradiate said object;

an endoscope having an elongated insertion part capable of being inserted into said living body and operable to collect said reflected and fluorescence light;

a solid-state imaging device coupled to said endoscope for receiving said reflected and fluorescence light collected by said endoscope, said solid-state imaging device being provided at a distal end of the insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device, and effective to provide ~~and having~~ a variable amplification factor and a variable amplitude output related to said received light in said visible spectrum and a value of said amplification factor;

a signal processor coupled to said solid-state imaging device for processing said output from said solid-state imaging device and producing a video signal;

a display device coupled to said signal processor for receiving said video signal and displaying an image represented by said video signal;

a controller for controlling said amplification factor in said solid-state imaging device to provide greater amplification for said received fluorescence light than for said received reflected light; and

a light source controller for controlling power supplied to said light source in relation to a switching state of said light switching device, such that said light source operates at higher power when said non-visible spectrum is switched to irradiate said object than when said visible spectrum is switched to irradiate said object.

37. (Previously Presented) An endoscope system according to claim 36, further comprising a wavelength limiter in an optical path linking said object and said solid-state imaging device for preventing transmission of light with wavelengths in said non-visible spectrum and permitting transmission of at least a portion of said reflected and fluorescence light.

38. (Previously Presented) An endoscope system according to claim 36, wherein said non-visible light spectrum is operable to excite a fluorescent substance introduced into said object to produce said fluorescence light.

39. (Previously Presented) An endoscope system according to claim 38, further comprising a variable light diaphragm in an optical path linking said light source and said object and controllable based on said output from said solid-state imaging device to pass greater or lesser amounts of light from said light source.

40. (Currently Amended) An endoscope system, comprising:
a light source apparatus including a light for radiating light to an object and a first filter unit provided on an illumination path linking the light source and the object and including plural filters through which visible light having different spectra are successively irradiated to the object;
an endoscope having an elongated insertion part capable of being inserted into a living body;
a solid-state imaging device having a variable amplification factor provided to the endoscope for controlling an image brightness of a fluorescence image, the amplification factor

being varied without loss of resolution, and said solid-state imaging device being provided at a distal end of the insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device;

a signal processor for processing a signal output from the solid-state imaging device and producing a video signal;

a display device for displaying an image represented by the video signal;

a controller for controlling the amplification factor in the solid-state imaging device based on visible light received by the imaging device;[[,]] and

a second filter unit provided on the illumination path and including an infrared light transmission filter to produce fluorescent light.

41. (Previously Presented) An endoscope system according to claim 40, wherein the first filter unit transmits visible light to produce reflected light, and the display device can display a normal light image by the reflected light and a fluorescent light image by fluorescent light.

42. (Previously Presented) The endoscope system according to claim 41, wherein said first filter unit includes red, green and blue filters.

43. (Previously Presented) The endoscope system according to claim 41, wherein said variable amplification factor is varied based on an amplitude of a periodical signal controlled by said controller.

44. (Previously Presented) The endoscope system according to claim 41, wherein said controller controls said amplitude of said periodical signal depending on said spectrum irradiated to said object.

45. (Previously Presented) An endoscope system according to claim 41,

wherein the solid-state imaging device receives both the reflected light and the fluorescent light without changing an optical path thereof.

46. (Previously Presented) An endoscope system according to claim 45, wherein the second filter unit further includes a visible light transmission filter for transmitting the visible light, and

the controller controls an amplitude of a periodical signal in response to switching between the visible light transmission filter and the infrared light transmission filter.

47. (Previously Presented) An endoscope system according to claim 46, wherein the second filter unit is composed of a rotary filter, and
the controller controls the amplification factor in the solid-state imaging device in correspondence with rotation of the second filter unit.

48. (Previously Presented) An endoscope system according to claim 46, wherein the second filter unit is provided between the first filter unit and the light.

49. (Previously Presented) An endoscope system according to claim 46, further comprising:

an amount-of-light controller for controlling amounts of the light, the amount-of-light controller controlling the amount of the light so as to operate the light with a higher output when irradiating excitation light to an object by the infrared light transmission filter than that when irradiating the visible light to the object by the visible light transmission filter.

50. (Previously Presented) An endoscope system according to claim 46, further comprising:

a variable light diaphragm provided in an illumination optical path for controlling amounts of illumination light irradiated to the object; and

a diaphragm controller for controlling the variable light diaphragm, the diaphragm controller controlling the variable light diaphragm so that the amount of the light irradiated to the object when irradiating the excitation light to the object by the infrared light transmission filter may be greater than that when irradiating the visible light to the object by the visible light transmission filter.

51. (Previously Presented) An endoscope system according to claim 46, further comprising an amount-of-light limiting filter that limits an amount of illumination light irradiated to the object when irradiating the visible light to the object by the visible light transmission filter.

52. (Previously Presented) An endoscope system, comprising:
a light source apparatus including a light for irradiating an object;
an endoscope having an insertion part capable of being inserted into a living body;
a solid-state imaging device for imaging an object in the living body by the endoscope, the solid-state imaging device having a variable amplification factor that is variable without loss of resolution and provided for receiving reflected light and fluorescent light without changing an optical path;
a filter unit provided on an illumination optical path between the light source and the object, the filter unit including a visible light transmission filter for transmitting visible light to the object to produce reflected light and an excitation light transmission filter for transmitting excitation light to produce fluorescent light;
an excitation light cutoff filter provided on an optical path linking the object and the solid-state imaging device for preventing transmission of the excitation light;
a filter switching device for providing the visible light transmission filter and the excitation light transmission filter selectively on the illumination light path to switch the illumination light irradiated to the object between the visible light and the excitation light;
a signal processor for processing an output signal from the solid-state imaging device;

a display device for displaying an image based on the signal processed by the signal processor, the display device is capable of displaying a normal light image by the reflected light and a fluorescent light image by the fluorescent light; and

a controller for controlling an amplification factor in the solid-state imaging device, the controller controlling the amplification factor in correspondence with the switching of the filter switching device.

53. (Previously Presented) An endoscope system according to claim 52, further comprising:

an amount-of-light controller for controlling an amount of the light, the amount-of-light controller controlling the amount of the light so as to operate the light with a higher output when irradiating excitation light to an object by the excitation light transmission filter than that when irradiating the visible light to the object by the visible light transmission filter.

54. (Previously Presented) An endoscope system according to claim 52, further comprising:

a variable light diaphragm provide in an illumination optical path for controlling amounts of illumination light irradiated to the object; and

a diaphragm controller for controlling the variable light diaphragm, the diaphragm controller controlling the variable light diaphragm so that the amounts of the light irradiated to the object when irradiating the excitation light to the object by the excitation light transmission filter may be greater than that when irradiating the visible light to the object by the visible light transmission filter.

55. (Previously Presented) An endoscope system according to claim 52, further comprising an amount-of-light limiting filter limits an amount of illumination light irradiated to the object when irradiating the visible light to the object by the visible light transmission filter.

56. (Previously Presented) An endoscope system according to claim 53, wherein the visible light transmission filter and the excitation light transmission filter are provided in parallel with a direction of rotation of the filter unit.

57. (Previously Presented) An endoscope system according to claim 53, further comprising:
an RGB rotary filter provided on the illumination optical path, the RGB filter including red, green and blue filters.

58. (Previously Presented) An endoscope system according to claim 57, wherein the filter unit is provided between the light and the RGB filter.

59. (Previously Presented) An endoscope system according to claim 54, wherein the visible light transmission filter and the excitation light transmission filter are provided to parallel with a direction of rotation of the filter unit.

60. (Previously Presented) An endoscope system according to claim 54, further comprising:
an RGB rotary filter provided on the illumination optical path, the RGB filter including red, green and blue filters.

61. (Previously Presented) An endoscope system according to claim 60, wherein the filter unit is provided between the light source and the RGB filter.

62. (Previously Presented) An endoscope system according to claim 55, wherein the visible light transmission filter and the excitation light transmission filter are provided in parallel with a direction of rotation of the filter unit.

63. (Previously Presented) An endoscope system according to claim 55, further comprising:

an RGB rotary filter provided on the illumination optical path, the RGB filter including red, green and blue filters.

64. (Previously Presented) An endoscope system according to claim 63, wherein the filter unit is provided between the light and the RGB filter.

65. (Previously Presented) An endoscope system, comprising:
a light source apparatus including a light for irradiating an object;
an endoscope having an insertion part capable of being inserted into a living body;
a solid-state imaging device for imaging an object in the living body by the endoscope, the solid-state imaging device having a variable amplification factor that is variable without loss of resolution;

a filter unit provided on an illumination optical path between the light source and the object, the filter unit including a visible light transmission filter for transmitting visible light to the object to produce reflected light and an excitation light to produce an image;

an excitation light cutoff filter provided on an optical path linking the object and the solid-state imaging device for preventing transmission of the excitation light;

a filter switching device for providing the visible light transmission filter and the excitation light transmission filter selectively on the illumination light path to switch the illumination light irradiated to the object between the visible light and the excitation light;

a signal processor for processing an output signal from the solid-state imaging device;

a display device for displaying an image based on the signal processed by the signal processor; the display device is capable of displaying a normal light image by the reflected light and a fluorescent light image by the fluorescent light; and

a controller for controlling an amplification factor in the solid-state imaging device; the controller controlling the amplification factor in correspondence with the switching of the filter switching device.

66. (Previously Presented) An endoscope system according to claim 65, further comprising:

a variable light diaphragm provided in an illumination optical path for controlling amounts of illumination light irradiated to the object; and

a diaphragm controller for controlling the variable light diaphragm, the diaphragm controller controlling the variable light diaphragm so that the amounts of the light irradiated to the object when irradiating the excitation light to the object by the excitation light transmission filter may be greater than that when irradiating the visible light to the object by the visible light transmission filter.

67. (Previously Presented) An endoscope system according to claim 65, wherein the visible light transmission filter and the excitation light transmission filter are provided in parallel with a direction of rotation of the filter unit.

68. (Previously Presented) An endoscope system according to claim 65, further comprising:

an RGB rotary filter provided on the illumination optical path, the RGB filter including red, green and blue fibers.

69. (Previously Presented) An endoscope system according to claim 68, wherein the filter unit is provided between the light and the RGB filter.

70. (Previously Presented) An endoscope system according to claim 65, further comprising:

an amount-of-light controller for controlling an amount of the light, the amount-of-light controller controlling the amount of the light so as to operate the light with a higher output when irradiating excitation light to an object by the excitation light transmission filter than that when irradiating the visible light to the object by the visible light transmission filter.

71. (Previously Presented) An endoscope system according to claim 70, wherein the visible light transmission filter and the excitation light transmission filter are provided in parallel with a direction of rotation of the filter unit.

72. (Previously Presented) An endoscope system according to claim 70, further comprising:
an RGB rotary filter provided on the illumination optical path, the RGB filter including red, green and blue filters.

73. (Previously Presented) An endoscope system according to claim 71, wherein the filter unit is provided between the light and the RGB filter.

74. (Previously Presented) An endoscope system comprising:
a light source means including a light for irradiating an object;
an endoscope having an insertion part capable of being inserted into a living body;
an imaging means having a variable amplification factor that is variable without loss of resolution;
an illumination light switching means provided on an illumination optical path between the light source means and the object, the illumination light switching means being able to irradiate visible light to produce reflected light and excitation light to produce fluorescent light selectively to an object;

a switching means for switching the illumination light switching means to switch between a normal light observation by the visible light and a fluorescent light observation by the excitation light;

a signal processing means for processing an output signal from the imaging means;

a display means for displaying an image based on the signal processed by the signal processing means, the display means is capable of displaying a normal light image by the reflected light and a fluorescent light image by the fluorescent light; and

an amplification controlling means for controlling an amplification factor of the imaging means, the amplification controlling means controlling the amplification factor in correspondence with the switching of the filter switching means.

75. (Previously Presented) An endoscope system according to claim 74, further comprising:

a diaphragm provided in an illumination optical path for controlling an amount of illumination light irradiated to the object; and

a diaphragm controlling means for controlling the diaphragm, the diaphragm controlling means controlling the diaphragm so that the amount of the light irradiated to the object at the time of the fluorescent light observation may be greater than at the time of the normal light observation.

76. (Previously Presented) An endoscope system according to claim 75, further comprising:

an amount-of-light controlling means for controlling an amount of the light, the amount-of-light controlling means controlling the amount of the light so that the amount of light irradiated to the object at the time of the fluorescent light observation may be greater than that at the time of the normal light observation.

77. (Currently Amended) An endoscope system comprising:

a light source apparatus for radiating irradiation light to an object in a living body to produce reflected and fluorescent light;

an endoscope including a solid-state imaging device having a variable amplification factor for controlling an image brightness of a fluorescence image, the solid-state imaging device receiving the reflected and fluorescent light, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device;

a signal processor for processing a signal output from the solid-state imaging device and producing a video signal;

a controller for controlling the amplification factor in the solid-state imaging device based on the visible light received by the imaging device;

a switching device for switching the irradiation light from the light source apparatus to provide a first spectrum to excite a fluorescent substance contained in the object and a second spectrum including at least a part of a spectrum of visible light; and

a wavelength limiter in an optical path linking the object and the solid-state imaging device for preventing transmission of light with wavelengths in the first spectrum and permitting transmission of light with wavelengths in at least a part of a fluorescent spectrum of the fluorescent light and in at least a part of the second spectrum.

78. (Currently Amended) An endoscope system comprising:

a light source apparatus for radiating irradiation light in at least a visible and non-visible spectrum to an object in a living body to produce reflected and fluorescent light, the light source apparatus including a light;

an irradiation light switching device in an optical path between the light and the object for switching between the visible and non-visible spectrum to irradiate the object;

an endoscope including a solid-state imaging device for receiving the reflected and fluorescent light, the solid-state imaging device having a variable amplification factor for

controlling an image brightness of a fluorescence image, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device;

a signal processor for processing a signal output from the solid-state imaging device and producing a video signal;

a controller for controlling the amplification factor in the solid-state imaging device based on visible light received by the imaging device; and

a light controller for controlling power supplied to the light in relation to a switching state of the irradiation light switching device, such that the light operates at higher power when the non-visible spectrum is switched to irradiate the object than when the visible spectrum is switched to irradiate the object.

79. (Currently Amended) An endoscope system comprising:

a light source apparatus including a light for radiating light to an object and a first filter unit provided on an illumination path linking the light and the object and including plural filters through which visible light having different spectra are successively irradiated to the object;

an endoscope including a solid-state imaging device having a variable amplification factor for controlling an image brightness of a fluorescence image, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device;

a signal processor for processing a signal output from the solid-state imaging device and producing a video signal;

a controller for controlling the amplification factor in the solid-state imaging device based on visible light received by the imaging device; and

a second filter unit provided on the illumination path and including an excitation light transmission filter to produce fluorescent light.

80. (Currently Amended) An endoscope system comprising:

a light source apparatus including a light for irradiating an object;

an endoscope including a solid-state imaging device having a variable amplification factor, the solid-state imaging device receiving the reflected and fluorescent light without changing an optical path;

a filter unit provided on an illumination optical path between the light and the object, the filter unit including a visible light transmission filter for transmitting visible light to the object to produce reflected light and an excitation light transmission filter for transmitting excitation light to produce fluorescent light;

an excitation light cutoff filter provided on an optical path linking the object and the solid-state imaging device for preventing transmission of the excitation light;

a filter switching device for providing the visible light transmission filter and the excitation light transmission filter selectively on the illumination light path to switch the illumination light irradiated on the object between the visible light and the excitation light;

a signal processor for processing an output signal from the solid-state imaging device; and

a controller for controlling an amplification factor in the solid-state imaging device for controlling an image brightness of a fluorescence image based on visible light received by the imaging device, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device.

81. (Currently Amended) An endoscope system comprising:

a light source apparatus including a light for irradiating an object;

an endoscope including a solid-state imaging device having a variable amplification factor;

a filter unit provided on an illumination optical path between the light and the object, the filter unit including a visible light transmission filter for transmitting visible light to the object to

produce reflected light and an excitation light transmission filter for transmitting excitation light to produce fluorescent light;

an excitation light cutoff filter provided on an optical path linking the object and the solid-state imaging device for preventing transmission of the excitation light;

a filter switching device for providing the visible light transmission filter and the excitation light transmission filter selectively on the illumination light path to switch the illumination light irradiated to the object between the visible light and the excitation light;

a signal processor for processing an output signal from the solid-state imaging device; and

a controller for controlling an amplification factor in the solid-state imaging device for controlling an image brightness of a fluorescence image based on visible light received by the imaging device, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device.

82. (Currently Amended) An endoscope system comprising:

a light source means including a light for irradiating an object to produce reflected and fluorescent light;

an endoscope including an imaging means having a variable amplification factor for controlling an image brightness of a fluorescence image, and said imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the imaging device;

an illumination light switching means provided on an illumination optical path between the light and the object, the illumination light switching means being able to irradiate visible light to produce reflected light and excitation light to produce fluorescent light selectively to the object;

a switching means for switching the illumination light switching means to switch between a normal light observation by the visible light and a fluorescent light observation by the excitation light;

a signal processing means for processing an output signal from the imaging means; and

an amplification controlling means for controlling the amplification factor of the imaging means based on visible light received by the imaging device.

83. (Currently Amended) An endoscope system comprising:

a light source apparatus including a light for irradiating an object to produce reflected and fluorescent light;

an endoscope including a solid-state imaging device having a variable amplification factor for controlling an image brightness of a fluorescence image, and said solid-state imaging device being provided at a distal end of an insertion part of the endoscope and having an amplification function that serves to amplify a signal subjected to a photoelectric conversion inside the solid-state imaging device;

a filter unit provided on an illumination path between the light and the object, the filter unit including an excitation light transmission filter for transmitting excitation light to the object to produce fluorescent light;

a switching device that switches the irradiation light from the light source apparatus to produce the reflected light or the fluorescent light by selectively providing the excitation light transmission filter on the illuminating path;

a signal processor for processing an output signal from the solid-state imaging device;

and

a controller for controlling an amplification factor in the solid-state imaging device based on visible light received by the imaging device.